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ABSTRACT

This project was conducted to develop curriculum materials for classes in energy and water conservation for the Irrigation Technology Program at Walla Walla Community College. To develop the curriculum, the principal investigator read and analyzed materials on the subjects of water and energy conservation, participated in a short course on drip irrigation, contacted businesses in the West to discuss the practices used for water and energy conservation, and attended the 1984 International Irrigation Exposition and Conference. The final result was the development of two new three-quarter credit classes titled "Drip Irrigation" and "Water and Energy Conservation." It was found that there was a large demand from the irrigation industry for people with a background in energy and water conservation, so the classes were designed to supply those needs. In the future, sections of the classes will be used as short seminars. (Outlines of the two courses and a list of resources used are included as appendixes to this report.) (KC)

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ENERGY AND WATER CONSERVATION CURRICULUM DEVELOPMENT IN IRRIGATION TECHNOLOGY FOR THE PACIFIC NORTHWEST

FINAL REPORT

Project No. 84-ASY(164)NB

Curriculum Development Project
Conducted Under Public Law 94-482

U.S. DEPARTMENT OF EDUCATION
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RESEARCH COORDINATING UNIT
Washington State Commission for Vocational Education

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CURRICULUM DEVELOPMENT PROJECT
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The project reported herein was performed pursuant to a grant from the Research Coordinating Unit of the Washington State Commission for Vocational Education. Contractors undertaking such projects under the Commission for Vocational Education sponsorship are encouraged to express freely their professional judgement in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Commission for Vocational Education position or policy.

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DECEMBER 28, 1984

MAJOR OBJECTIVES

The major objectives of the project were to develop curriculum materials for classes in energy and water conservation for the Irrigation Technology Program at Walla Walla Community College by September 15, 1984.

SUMMARY OF ACTIVITIES

During the winter and spring of 1984, a large amount of materials were collected, read, and analyzed on the subjects of water and energy conservation. In March, the principal investigator participated in a short course on drip irrigation sponsored by the Irrigation Association at Cal-Poly San Luis Obispo.

Throughout the spring and summer, many businesses in the West were contacted to discuss the practices used for water and energy conservation. Throughout this time period, members of the Irrigation Technology Advisory Committee at Walla Walla Community College and other professional people in the irrigation industry were evaluating the material and injecting their own input to the project.

A trip to the 1984 International Irrigation Exposition and Conference held in Kansas City, Missouri was taken by the principal investigator in October. Many new products and concepts in energy and water conservation were revealed at the Expo.

SUMMARY OF RESULTS; ACCOMPLISHMENTS

The final result was the development of two new three-quarter credit classes to be taught through the Irrigation Technology Program at Walla Walla Community College. These classes are titled: Drip Irrigation, and Water and Energy Conservation.

MAJOR CONCLUSIONS AND RECOMMENDATIONS

The principal investigator found a large demand from the irrigation industry for people with some background in energy and water conservation. The classes developed were designed to supply those needs.

A further step in the future will be to take sections of the classes and use them as short seminars. They will become totally independent learning segments.

STATEMENT OF PROBLEM

Energy and water costs have risen dramatically in the past five years in the Pacific Northwest and the entire nation. During this time, much new technology has been developed to counteract the problems. However, no educational program has been designed to train people how to use this new technology.

In 1978, there were 2,400 acres drip irrigated in the state of Washington.[1] This increased to 4,500 acres by 1981.[2] Industry indications are that the development of drip irrigated acres has begun to accelerate even faster in the last two years due to the increased plantings of orchards, vineyards, and other perennial crops that are conducive to this method of irrigation.

In 1978, there were 277,000 acres under center pivot irrigation.[1] This increased to 388,000 by 1981.[2] Industry is seeing a steady growth in this trend.

What are the implications? Irrigated acres are growing steadily in this state. As more acres are watered, our water resources are stretched farther and farther. Lack of available water has even stopped irrigation development in many areas of Washington. Ways of using available water more efficiently so more acres can be covered is the only solution to this problem.

Electrical costs have increased approximately 120 percent over the last five years in the Pacific Northwest.[3] The solution to reduce power costs on farm are three-fold: 1. Install new low energy use irrigation such as drip or low pressure center pivot systems. 2. Convert existing center pivot systems from high to low pressure. 3. Improve water efficiency so less pumping needs to take place to cover the same amount of acres. Combinations of these solutions can also occur.

A high degree of technology exists in all of the above-mentioned solutions. Design, operation, and maintenance of these advanced irrigation systems requires some technical training. This training is not available at present.

The demand is apparent for further education in the areas discussed. There are no existing programs to do the job. The Irrigation Technology Program at Walla Walla Community College has the personnel and industry connections to develop and implement the necessary programs. This grant is designed to develop new classes that will compliment the existing program and create a positive continuing education program that the irrigation industry needs immediately.

1. 1978 Irrigation Survey, Irrigation Journal, P.O. Drawer 77, Elm Grove, WI 53122.

2. 1981 Irrigation Survey, Irrigation Journal, P.O. Drawer 77, Elm Grove, WI 53122.

3. Data compiled by Pacific Power and Light Company, 27 N. 2nd, Walla Walla, WA 99362.

MAIN OBJECTIVE

To develop curriculum materials for programs in energy and water conservation in Irrigation Technology at Walla Walla Community College by September 15, 1984.

SUB-OBJECTIVES

I. To develop curriculum materials for a course in Drip Irrigation at WWCC from the current lack of offering to a fully developed course of instruction for a minimum of twelve students per year by September 15, 1984.

II. To develop curriculum materials for a course in Water Scheduling at WWCC from the current lack of offering to a fully developed course of instruction for a minimum of twelve students per year by September 15, 1984.

III. To develop a curriculum materials for a course in Water and Energy Conservation at WWCC from the current lack of offering to a fully developed course of instruction for a minimum of twelve students per year by September 15, 1984.

DESCRIPTION OF PROJECT

In the past five years, a huge transition has taken place in the irrigation industry. Water has become more scarce. Electricity has become more expensive. Commodity prices have fallen.

This three-fold dilemma needs to be met. Farmers and irrigation equipment dealers need to learn how to better manage and conserve their water and electricity to reduce costs and at the same time maintain or increase production.

New irrigation methods and new types of irrigation equipment are making these needs attainable. It is now a matter of getting the right information to the right people in a timely manner.

The Irrigation Technology Program at Walla Walla Community College took up the challenge of filling the void of irrigation technologists in 1977. We are doing a good job of it and plan to continue to do so. However, a new challenge is upon the irrigation industry and we plan to develop programs to meet it head on.

The immediate goal of this project was to develop three new classes for the Irrigation Technology Program. They were to be: Design and Installation of Drip Irrigation Systems, Methods of Water Scheduling, and Water and Energy Conservation.

Implementation of these classes would begin Fall Quarter 1984. Research and Development would occur between January 3 and September 15, 1984. It was estimated that each class would be taught once a year with a minimum of twelve students in each class.

Much time and travel went into investigating the problems at hand. Many irrigation dealers in the Pacific Northwest and California were called upon to give input. A number of Pacific Northwest farmers also contributed their solutions to the water and energy crunch. Manufacturers were the most valuable group of support with much state-of-the-art information and tentative plans on water and energy conservation.

RESULTS AND ACCOMPLISHMENTS

Two classes have emerged from the energy put into the project. They are: Drip Irrigation (Appendix B) and Water and Energy Conservation (Appendix C). Both are designed to be taught as lecture courses, 33 hours in length, with three quarter credits awarded each upon completion.

Three classes were proposed originally. Drip Irrigation was developed as planned. However, the other two tentative classes tended to overlap so much that only one class was made up, Water and Energy Conservation, which includes the area of Water Scheduling.

The course, Water and Energy Conservation, is designed in sections so that it can be used piece by piece and taught as short seminars. This gives tremendous flexibility in the area of continuing education.

A final result in this project was the further education of the principal investigator and lead instructor of the Irrigation Technology Program at Walla Walla Community College, Greg Farrens. It has helped him stay current with a rapidly changing industry.

EVALUATION

This project has provided Walla Walla Community College an opportunity to develop courses needed to keep the Irrigation Technology Program up-to-date and effective in meeting the needs of irrigated agriculture in the Pacific Northwest. The materials developed for Drip Irrigation and Water and Energy Conservation are important for the changing economy in irrigated agriculture. In this regard, this project has been very successful in meeting its objectives.

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

This project has contributed to the content of the Irrigation Technology Program at Walla Walla Community College. The courses developed are being taught as a part of this program. Federal funds made available to WWCC for this project have enabled the college to contribute to the development of curriculum for a unique vocational program and contribute to the development of faculty as a result of conducting this project. The implications are that vocational education has been improved. The only recommendation would be that this type of project be continued in future years and that small grants such as this one be funded to meet specific curriculum needs at the local level.

PROJECT DISSEMINATION ACTIVITIES

The two courses developed have been incorporated into the Irrigation Technology Program at Walla Walla Community College. Drip Irrigation was taught Fall Quarter, 1984 to nine students and will be offered yearly in fall quarter. Water and Energy Conservation will be taught Winter Quarter, 1985 to at least eleven students and will be offered yearly in winter quarter. Next year, approximately 20 students will take each class, as it is offered to the second-year Irrigation Technology students and the first-year enrollment is 21.

Future plans are to offer threse two classes as continuing education. This will not happen until adequate staff is available. Our goal at WWCC is next year. Also planned is to break the classes down into seminars and begin offering them next year also. Our service area is tentatively the greater Columbia Basin region in Washington and Oregon. WWCC has already had three offers from outlying areas to help sponsor such seminars.

APPENDIX A

Macerials Researched

1. Irrigation, 5th Edition, 1983, The Irrigation Association, Pair, Hinz, Frost, Sneed, and Schiltz.

2. Design and Operation of Farm Irrigation Systems, 1980, American Society of Agricultural Engineers, M.E. Jensen.

3. Crop-Water Relations, 1983, John Wiley and Sons, Inc. I. D. Teare and M. M. Peet.

4. Irrigation Design and Practice, 2nd Edition, 1980, Cornell University Press, B. Withers and S. Vipond.

5. Irrigation Scheduling For Water and Energy Conservation in the 80's, 1981, American Society of Agricultural Engineers, Proceedings of 1981 Irrigation Scheduling Conference.

6. Water Production Functions for Irrigated Agriculture, 1978, The Iowa State University Press, R. W. Hexemand, E. O. Heady.

7. Pump Application Engineering, 1971, McGraw-Hill, Inc. T. G. Hicks and T. W. Edwards.

8. Farm Irrigation System Evaluation: A Guide for Management, 1978, Utah State University, J. L. Merriam and J. Kellar.

9. CRC Handbook of Irrigation Technology, Volumes I and II-1982 and 1983, CRC Press, H. J. Finkel.

10. Irrigation Practice and Water Management, 1971, Food and Agricultural Organization of the United Nations.

11. Trickle Irrigation, 1973, Food and Agricultural Organization of the United Nations.

12. National Engineering Handbook, Section 15, Chapter 7, Trickle Irrigation, U. S. Department of Agriculture, S.C.S.

13. Drip Irrigation, 1976, Drip Irrigation Scientific Publications, D. Goldberg, B. Garnet, D. Rimon.

Many magazines including:

Irrigation Age
Irrigation Journal
Ag Marketer
Farm Journal
Successful Farming

Magazines--cont'd:

Landscape and Irrigation
Western Hay and Grain
Washington Farmer-Stockman
Agricultural Engineering
Irrigation News
Citrus and Vegetables

Hundreds of trade and technical pamphlets from manufacturers, consumer groups, universities, and distributors on file with the Irrigation Technology Program at Walla Walla Community College.

APPENDIX B

Course Outline

Department: Irrigation Technology Instructor: Greg Farrens

Curriculum: Walla Walla Community College

Course Title and Number: Drip Irrigation IRT 120

Type of Course: Familiarization and application of drip irrigation and its components.

Length of Course: 33 hours (Lecture)

Credit Hours: 3

Class Size: Maximum 25

Prerequisite: None

Course Description: Introduction to drip irrigation concepts, methods, and components. Basic drip system maintenance, trouble-shooting, and design will be analyzed.

Course Objectives: Upon completion of this course, the student will be able to:

1. Interpret drip irrigation concepts and methods.
2. Identify drip system components.
3. Perform maintenance on drip systems.
4. Analyze and repair problems in drip systems.
5. Design basic drip systems.

Reference Text: National Engineering Handbook, Section 15, Chapter 7, Trickle Irrigation, U. S. Department of Agriculture, S.C.S.

Additional References: Supplemental materials and trade literature will be supplied.

Method of Instruction

30 1-hour lectures
One ½ day field trip

Student Activity

Class discussion, homework assignments, designs, and participation in a field trip.

Major Divisions	Estimated Time Allocation
Concept of Drip Irrigation	1 hr.
Plant Needs	4 hrs.
Methods of Drip Irrigation	2 hrs.
Components	6 hrs.

Major Divisions---Cont'd:	Estimated Time Allocation
Chemical Injection	2 hrs.
Maintenance	2 hrs.
Troubleshooting	3 hrs.
Design	10 hrs.
Field Trip	3 hrs.

Concept of Drip Irrigation

Upon completion of this course segment, the student will be able to interpret the concept of drip irrigation. One hour of class time will be used to:

a. define drip irrigation
b. give a brief history of drip irrigation
c. explain its current uses

Plant Needs

Upon completion of this course segment, the student will be able to analyze plant water needs in regard to drip irrigation water application. Four hours of class time will be used to:

a. evaluate consumptive use in various plants and climates
b. identify water efficiency
c. determine location of water application through drip systems
d. analyze water movement through various soil structures and textures
e. consider potential salt problems due to drip irrigation

Methods of Drip Irrigation

Upon completion of this course segment, the student will be able to differentiate between various types of drip systems. Two hours of class time will be used to analyze:

a. leaky hose
   i.e. above ground
   i.e. below ground
b. drip
   i.e. above ground
   i.e. below ground
c. bubblers
d. micro sprinklers
e. mini sprinklers

Components

Upon completion of this course segment, the student will be able to identify various drip components. Six hours of class time will be used to describe:

a. emitters and sprinklers
b. tubing
c. fittings
d. pipe
e. filters
f. pressure regulators
g. valves
h. injectors
i. pumps
j. controllers

Chemical Injection

Upon completion of this course segment, the student will be able to determine chemicals and methods of applying chemicals that are safe and necessary to use in drip systems. Two hours of class time will be used to analyze:

a. fertilizers
b. acids
c. chlorines

Maintenance

Upon completion of this course segment, the student will be able to perform general maintenance on a drip system. Two hours of class time will be used to demonstrate maintenance on:

a. emitters and sprinklers
b. filters
c. pressure regulators
d. valves
e. pumps
f. controllers

Troubleshooting

Upon completion of this course segment, the student will be able to troubleshoot common problems that occur in a drip system. Three hours of class time will be used to demonstrate troubleshooting techniques on:

a. emitters
b. filters
c. pressure regulators
d. valves

Troubleshooting---Cont'd:

e. injection systems
f. pumps
g. controllers

Design of Drip Systems

Upon completion of this course segment, the student will be able to design basic drip systems that are hydraulically sound, operational, and economical by selecting, coordinating, and pricing the proper components. Ten hours of class time will be used to size and combine:

a. emitters or sprinklers
b. tubing
c. manifolds
d. main lines
e. valves
f. injectors
g. filters
h. pumps
i. controllers

APPENDIX C

Course Outline

Department:	Irrigation Technology Instructor: Greg Farrens
Curriculum:	Walla Walla Community College
Course Title and Number:	Water and Energy Conservation IRT 130
Length of Course:	33 hours (Lecture)
Credit Hours:	3
Class Size:	Maximum 25
Prerequisite:	None
Course Description:	Discussion of techniques used in the irrigation industry to reduce water and/or energy consumption on the farm.
Course Objectives:	Upon completion of this course, the student will be able to: 1. Analyze plant-soil-water relationships. 2. Perform soil moisture measurements and water scheduling. 3. Identify irrigation system ineffeciencies in water and energy use. 4. Calculate costs of installing and operating various irrigation systems.
References:	Trade literature and supplemental materials will will be supplied.

Method of Instruction

33 1-hour lectures

Student Activity

Class discussion, homework assignments, independent research.

Major Divisions	Estimated Time Allocation
Water Conservation-The Problem	1 hr.
Soil Types	2 hrs.
Plant Needs	2 hrs.
Cultural Farming Practices	1 hr.
Irrigation Systems	3 hrs.
Salt Buildup Considerations	1 hr.
Soil Moisture Measurement	1 hr.
Water Scheduling	5 hrs.
Energy Conservation-The Need	1 hr.
Power Rate Structures	3 hrs.
Irrigation Component Efficiencies	6 hrs.
Total Irrigation System Economics	7 hrs.

Water Conservation-The Problem

Upon completion of this course segment. the student will be able to recognize the need for water conservation. One hour of class time will be used to:

a. give a history of water useage
b. describe today's water needs and availability

Soil Types

Upon completion of this course segment, the student will be able to identify problems with various soils and how water moves through them. Two hours of class time will be used to:

a. evaluate different soil types
b. analyze water movement through soils
c. identify problem conditions with various soils

Plant Needs

Upon completion of this course segment, the student will be able to analyze plant water needs. Two hours of class time will be used to:

a. evaluate various plant water needs throughout a growing season
b. identify sources of water to meet the water needs

Cultural Farming Practices

Upon completion of this course segment, the student will be able to identify cultural farming practices that improve or harm water conservation. One hour of class time will be used to:

a. identify good cultural practices
b. identify bad cultural practices
c. describe some solutions in improving existing cultural practices

Irrigation Systems

Upon completion of this course segment, the student will be able to analyze irrigation systems for their water efficiencies. Three hours of class time will be used to:

a. identify water conveyance losses
b. identify water distribution losses
c. calculate water use efficiencies
d. describe some solutions to minimize water loss and increase efficiencies

Salt Buildup Considerations

Upon completion of this course segment, the student will be able to identify salt accumulations in soils and methods of treatment. One hour of class time will be used to:

a. describe potential salt problems from the water supply
b. analyze soils for salt accumulation
c. describe leaching techniques
d. explain chemical treatments

Soil Moisture Measurement

Upon completion of this course segment, the student will be able to perform various soil moisture measurements. One hour of class time will be used to describe:

a. the gravimetric method
b. the tensiometer
c. the electrical resistance method
d. the neutron probe

Water Scheduling

Upon completion of this course segment, the student will be able to perform various methods of water scheduling. Five hours of class time will be used to describe and perform water scheduling using:

a. soil conditions
b. plant conditions
c. record keeping
d. climatalogical data
e. evaporation pan readings

Energy Conservation-The Need

Upon completion of this course segment, the student will be able to recognize the need for energy conservation. One hour of class time will be used to:

a. give a history of energy useage and prices
b. describe today's scenario
c. look at the future of energy

Power Rate Structures

Upon completion of this course segment, the student will be able to calculate power costs from various power rate schedules. Three hours of class time will be used to:

a. describe various power rate schedules
b. calculate yearly cost of energy from a given rate schedule

Power Rate Structures---Cont'd:

c. compare power rate schedules
d. look at alternative energy supplies

Irrigation Component Efficiencies

Upon completion of this course segment, the student will be able to analyze irrigation system components for their energy and/or hydraulic efficiencies. Six hours of class time will be used to analyze and recommend efficiency improvements on:

a. pumps
b. power units
c. piping
d. distribution systems (laterals)
    i.e. center pivots and linear/laterals
    i.e. hand lines and wheel lines
    i.e. solid set sprinklers
    i.e. drip
e. chemical injection

Total Irrigation System Economics

Upon completion of this course segment, the student will be able to calculate the costs of owning and operating an irrigation system. Seven hours of class time will be used to:

a. describe capital on operating costs
b. calculate yearly cost of operation
c. compare similar systems for most economic operation
d. demonstrate savings by upgrading existing irrigation systems